

CHAPTER 8 - REFERENCES

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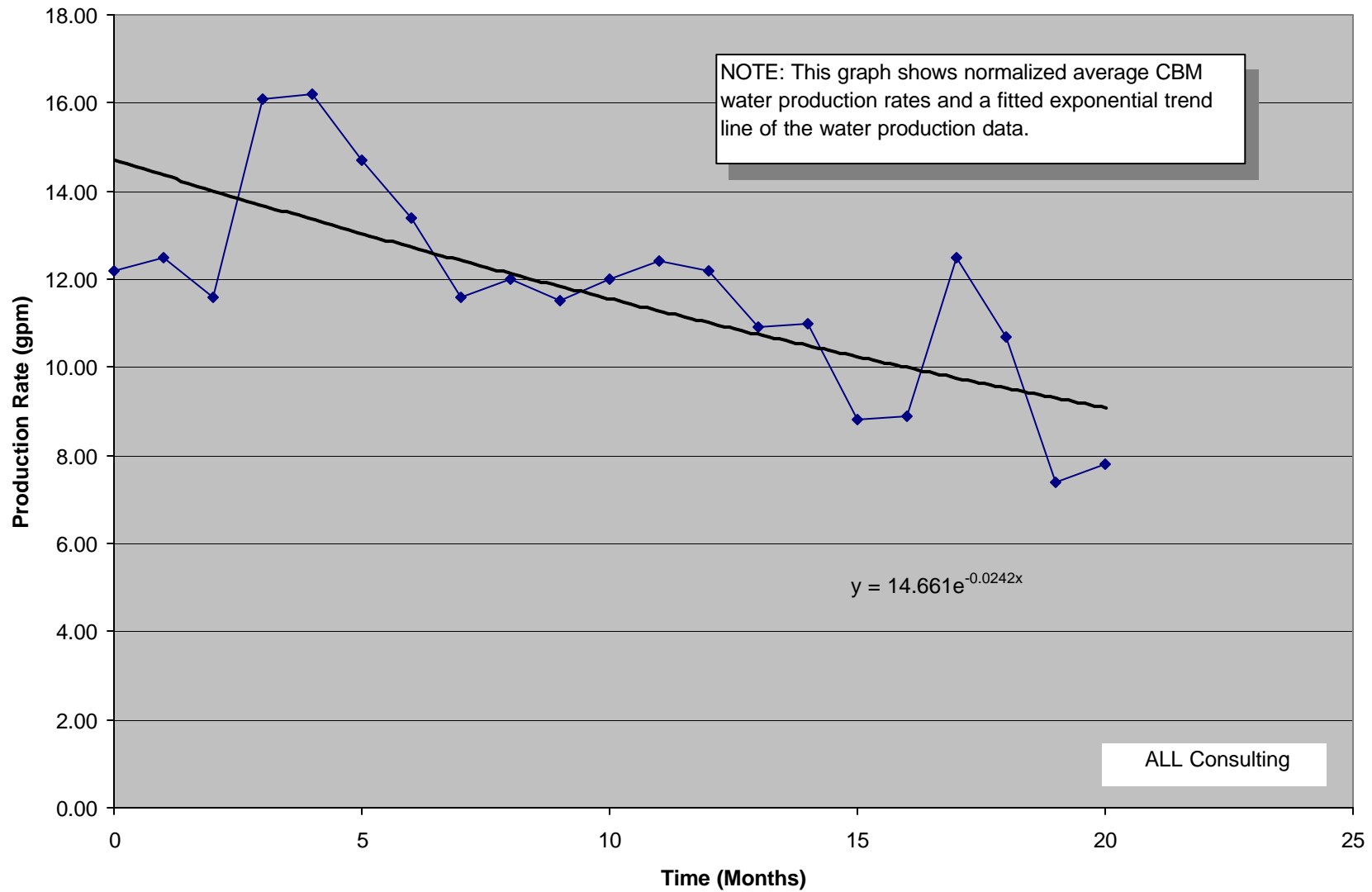
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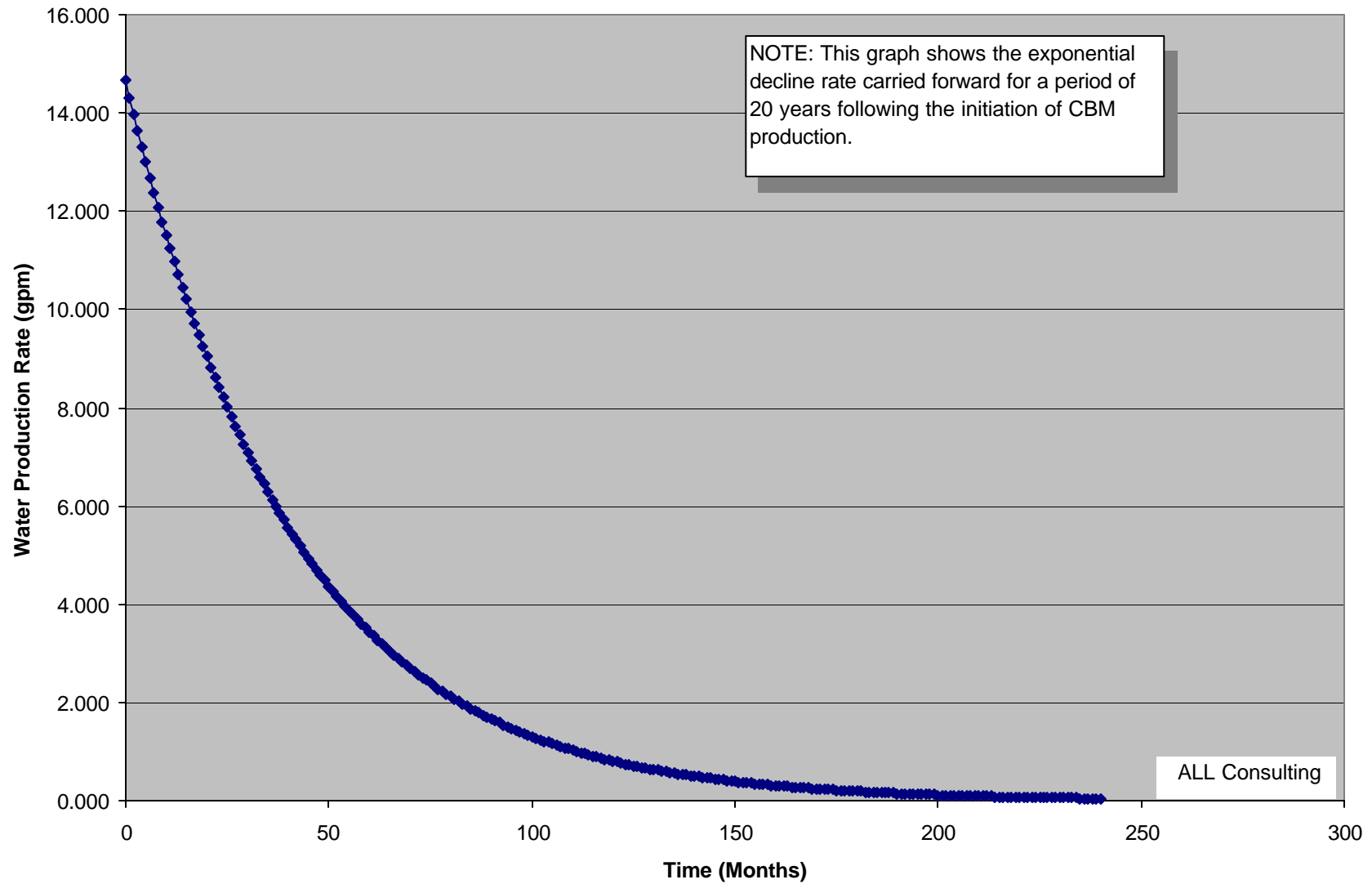
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APPENDIX A
CX RANCH WATER PRODUCTION DECLINE ANALYSIS

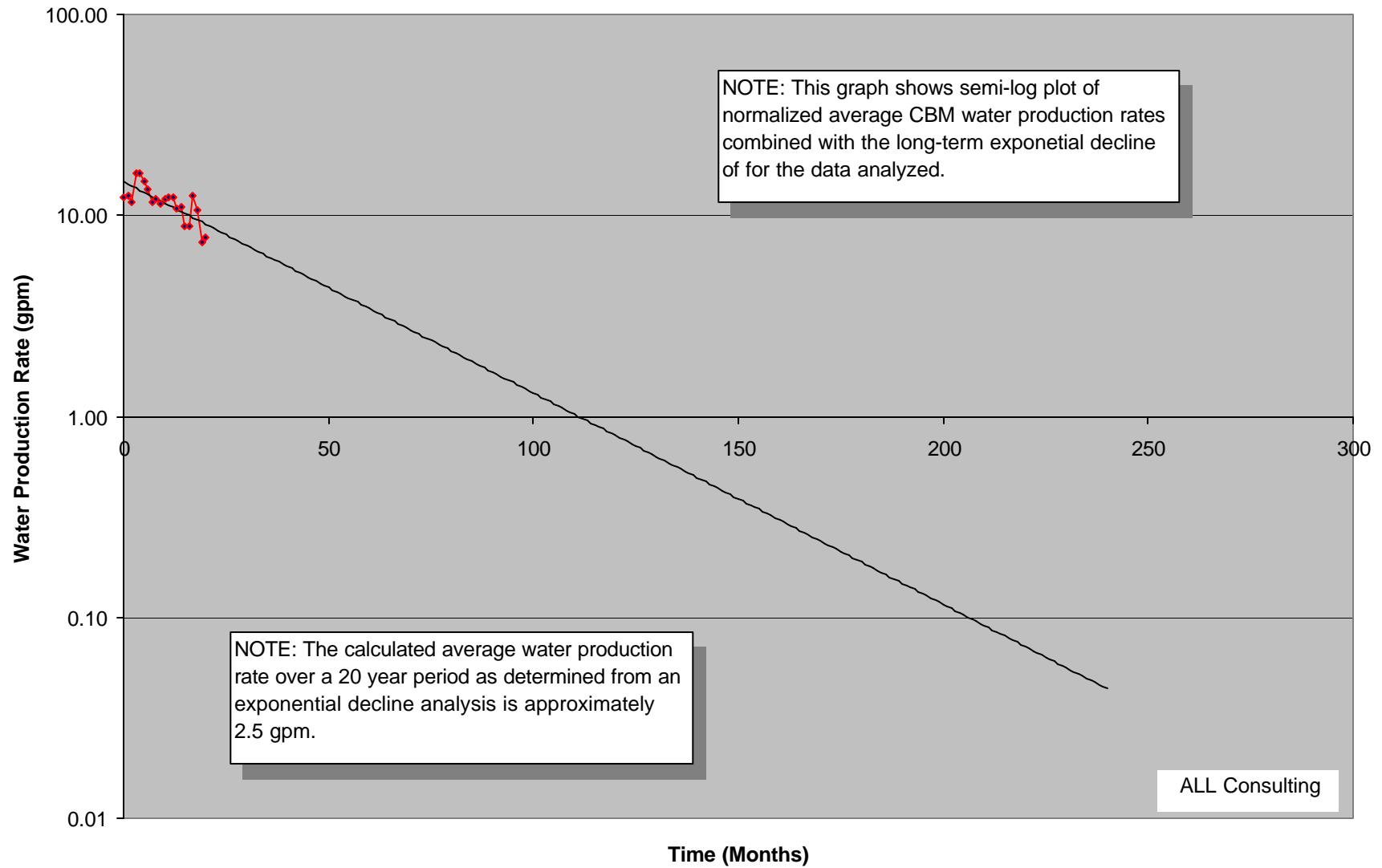
Normalized Average CBM Water Production Rates



CBM Water Production Exponential Decline Analysis



CBM Combined Water Production and Decline Analysis



CX Ranch Water Production Decline Analysis Data

Months	Rate	Decline
0	12.20	14.661
1	12.50	14.310
2	11.60	13.968
3	16.10	13.634
4	16.20	13.308
5	14.70	12.990
6	13.40	12.680
7	11.60	12.376
8	12.00	12.080
9	11.50	11.792
10	12.00	11.510
11	12.40	11.235
12	12.20	10.966
13	10.90	10.704
14	11.00	10.448
15	8.80	10.198
16	8.90	9.954
17	12.50	9.716
18	10.70	9.484
19	7.40	9.257
20	7.80	9.036
21		8.820
22		8.609
23		8.403
24		8.202
25		8.006
26		7.815
27		7.628
28		7.445
29		7.267
30		7.094
31		6.924
32		6.758
33		6.597
34		6.439
35		6.285
36		6.135
37		5.988
38		5.845
39		5.705
40		5.569
41		5.436
42		5.306
43		5.179
44		5.055
45		4.934
46		4.816
47		4.701
48		4.589

CX Ranch Water Production Decline Analysis Data

Months	Rate	Decline
49		4.479
50		4.372
51		4.267
52		4.165
53		4.066
54		3.969
55		3.874
56		3.781
57		3.691
58		3.602
59		3.516
60		3.432
61		3.350
62		3.270
63		3.192
64		3.116
65		3.041
66		2.968
67		2.897
68		2.828
69		2.760
70		2.694
71		2.630
72		2.567
73		2.506
74		2.446
75		2.387
76		2.330
77		2.275
78		2.220
79		2.167
80		2.115
81		2.065
82		2.015
83		1.967
84		1.920
85		1.874
86		1.829
87		1.786
88		1.743
89		1.701
90		1.661
91		1.621
92		1.582
93		1.544
94		1.507
95		1.471
96		1.436
97		1.402

CX Ranch Water Production Decline Analysis Data

Months	Rate	Decline
98		1.368
99		1.336
100		1.304
101		1.273
102		1.242
103		1.212
104		1.183
105		1.155
106		1.127
107		1.101
108		1.074
109		1.049
110		1.023
111		0.999
112		0.975
113		0.952
114		0.929
115		0.907
116		0.885
117		0.864
118		0.843
119		0.823
120		0.803
121		0.784
122		0.766
123		0.747
124		0.729
125		0.712
126		0.695
127		0.678
128		0.662
129		0.646
130		0.631
131		0.616
132		0.601
133		0.587
134		0.573
135		0.559
136		0.546
137		0.532
138		0.520
139		0.507
140		0.495
141		0.483
142		0.472
143		0.461
144		0.450
145		0.439
146		0.428

CX Ranch Water Production Decline Analysis Data

Months	Rate	Decline
147		0.418
148		0.408
149		0.398
150		0.389
151		0.379
152		0.370
153		0.362
154		0.353
155		0.344
156		0.336
157		0.328
158		0.320
159		0.313
160		0.305
161		0.298
162		0.291
163		0.284
164		0.277
165		0.270
166		0.264
167		0.258
168		0.251
169		0.245
170		0.240
171		0.234
172		0.228
173		0.223
174		0.217
175		0.212
176		0.207
177		0.202
178		0.197
179		0.193
180		0.188
181		0.184
182		0.179
183		0.175
184		0.171
185		0.167
186		0.163
187		0.159
188		0.155
189		0.151
190		0.148
191		0.144
192		0.141
193		0.137
194		0.134
195		0.131

CX Ranch Water Production Decline Analysis Data

Months	Rate	Decline
196		0.128
197		0.125
198		0.122
199		0.119
200		0.116
201		0.113
202		0.110
203		0.108
204		0.105
205		0.103
206		0.100
207		0.098
208		0.096
209		0.093
210		0.091
211		0.089
212		0.087
213		0.085
214		0.083
215		0.081
216		0.079
217		0.077
218		0.075
219		0.073
220		0.071
221		0.070
222		0.068
223		0.066
224		0.065
225		0.063
226		0.062
227		0.060
228		0.059
229		0.057
230		0.056
231		0.055
232		0.053
233		0.052
234		0.051
235		0.050
236		0.049
237		0.047
238		0.046
239		0.045
240		0.044

APPENDIX B
WATER QUALITY DATA FROM THE ROSEBUD MINE, COLSTRIP, ROSEBUD COUNTY,
MONTANA

Appendix B - Rosebud Mine Area Groundwater Quality Data From MDEQ Files

Aquifer	Number of Samples	Calc. TDS	SAR	Ca	Mg	Na	K	Fe Diss.	Mn Diss.	Al Diss.	Bicarb.	CO3
Alluvium	1071	75 to 14,142 (610 samples, median=2647 mg/l)	0.29 to 20 (778 samples, median= 1.8)	780 to 807 mg/l (780 samples, median= 220 mg/l)	4 to 2140 mg/l (778 samples, median= 273 mg/l)	7 to 887 mg/l (778 samples, median= 174 mg/l)	0 to 38 mg/l (778 samples, median= 6.0 mg/l)	0 to 6.75 mg/l (774 samples, median= 0 mg/l)	0 to 12.6 mg/l (662 samples, median= 0.6 mg/l)	0 to 5.2 mg/l (757 samples, median= 0.0 mg/l)	54 to 1420 mg/l (778 samples, median= 535 mg/l)	0 to 12 mg/l (761 samples, median= 0.0 mg/l)
		46 to 10,392 mg/l (482 samples, median=1800 mg/l)	0.07 to 38 (581 samples, median= 2.04)	6 to 857 mg/l (587 samples, median= 153 mg/l)	3.0 to 1585 mg/l (587 samples, median= 120 mg/l)	1.0 to 965 mg/l (588 samples, median= 166 mg/l)	0 to 27.0 mg/l (588 samples, median= 5.0 mg/l)	0 to 37.10 mg/l (585 samples, median= 0.06 mg/l)	0 to 168 mg/l (516 samples, median= 0.10 mg/l)	0 to 6.2 mg/l (459 samples, median= 0.0 mg/l)	22.0 to 1098 mg/l (584 samples, median= 516 mg/l)	0 to 365 mg/l (559 samples, median= 0.0 mg/l)
Rosebud Coal	632	218 to 6269 mg/l (446 samples, median=1311 mg/l)	0 to 20 (520 samples, median= 1.34)	29 to 834 mg/l (524 samples, median= 139 mg/l)	17 to 807 mg/l (524 samples, median= 138 mg/l)	0.33 to 890 mg/l (522 samples, median= 97.0 mg/l)	0 to 41mg/l (522 samples, median= 5.0 mg/)	0 to 126 mg/l (517 samples, median= 0.04 mg/l)	0 to 5.70 mg/l (467 samples, median= 0.16 mg/l)	0 to 7.8 mg/l (361 samples, median= 0.0 mg/l)	25 to 1218 mg/l (521 samples, median= 546 mg/l)	0 to 33.0 mg/l (515 samples, median= 0.0 mg/l)
		456 to 6722 mg/l (166 samples, median=1654 mg/l)	0.12 to 55.8 (229 samples, median= 6.06)	2.0 to 729 mg/l (229 samples, median= 96 mg/l)	1.0 to 611 mg/l (229 samples, median= 82.0 mg/l)	7.0 to 1030 mg/l (229 samples, median= 328 mg/l)	0 to 34.0 mg/l (229 samples, median= 5.0 mg/l)	0 to 5.60 mg/l (224 samples, median= 0.03 mg/l)	0 to 1.03 mg/l (198 samples, median= 0.06 mg/l)	0 to 2.20 mg/l (221 samples, median= 0.0 mg/l)	142 to 1150 mg/l (228 samples, median= 498 mg/l)	0 to 18.0 mg/l (227 samples, median= 0.0 mg/l)
Sub-McKay Coal	294											

Appendix B - Rosebud Mine Area Groundwater Quality Data From MDEQ Files

Aquifer	Cl	SO4	Nitrite, Nitrate	F	As Diss.	B	Cd Diss.	Cr Diss.	Cu Diss.	Pb Diss.	Hg Diss.	Mb Diss.	Ni Diss.
		10 to 9330	0 to 351	0 to 3.10	0 to 0.01	0 to 38.9							
	0 to 262 mg/l (779 samples, median= 20 mg/l)	mg/l (778 samples, median= 1600 mg/l)	mg/l (762 samples, median= 0.22 mg/l)	mg/l (777 samples, median= 0.26 mg/l)	mg/l (82 samples, median= 0.01 mg/l)	mg/l (506 samples, median= 0.40 mg/l)	0 to 0.03 mg/l (755 samples, median= 0.0 mg/l)	0 to 0.04 mg/l (32 samples, median= 0.0 mg/l)	0 to 0.13 mg/l (684 samples, median= 0.0 mg/l)	0 to 0.16 mg/l (754 samples, median= 0.0 mg/l)	0 to 0.001 mg/l (681 samples, median= 0.0 mg/l)	0 to 0 mg/l (9 samples)	0 to 0.10 mg/l (20 samples, median= 0.0 mg/l)
Alluvium													
						0 to 17.90							
	0 to 189 mg/l (584 samples, median= 7.0 mg/l)	5 to 760 mg/l (582 samples, median= 935 mg/l)	0 to 6.60 mg/l (494 samples, median= 0.06 mg/l)	0 to 2.90 mg/l (584 samples, median= 0.23 mg/l)	0 to 0.01 mg/l (57 samples, median= 0.01 mg/l)	mg/l (387 samples, median= 0.40 mg/l)	0 to 0.03 mg/l (511 samples, median= 0.0 mg/l)	0 to 0.08 mg/l (20 samples, median= 0.0 mg/l)	0 to 0.14 mg/l (494 samples, median= 0.0 mg/l)	0 to 0.28 mg/l (519 samples, median= 0.0 mg/l)	0 to 0.002 mg/l (406 samples, median= 0.0 mg/l)	0 to 0.04 mg/l (10 samples, median= 0 mg/l)	0 to 0.10 mg/l (63 samples, median= 0.0 mg/l)
McKay Coal													
	0 to 143 mg/l (521 samples, median= 7.10 mg/l)	30 to 4520 mg/l (520 samples, median= 664 mg/l)	0 to 34.6 mg/l (382 samples, median= 0.05 mg/l)	0 to 2.19 mg/l (521 samples, median= 0.20 mg/l)	0 to 0.10 mg/l (38 samples, median= 0.01 mg/l)	0 to 14.7 mg/l (400 samples, median= 0.51 mg/l)	0 to 0.01 mg/l (459 samples, median= 0.0 mg/l)	0 to 0.12 mg/l (46 samples, median= 0.0 mg/l)	0 to 0.66 mg/l (465 samples, median= 0.0 mg/l)	0 to 0.10 mg/l (461 samples, median= 0.0 mg/l)	0 to 0.0024 (327 samples, median= 0 mg/l)		0 to 0.09 mg/l (1023 samples, median= 0.0 mg/l)
Rosebud Coal													
	0 to 81.0 mg/l (229 samples, median= 9.0 mg/l)	25.6 to 4120 mg/l (229 samples, median= 898 mg/l)	0 to 29.93 mg/l (227 samples, median= 0.05 mg/l)	0.04 to 5.0 mg/l (229 samples, median= 0.39 mg/l)	0.01 to 0.44 mg/l (24 samples, median= 0.41 mg/l)	0 to 1.40 mg/l (142 samples, median= 0.30 mg/l)	0 to 0.01 mg/l (224 samples, median= 0.0 mg/l)	0.0 mg/l(9 samples)	0 to 0.05 mg/l (198 samples, median= 0.0 mg/l)	0 to 0.14 mg/l (224 samples, median= 0.0 mg/l)	0 to 0.001 mg/l (197 samples, median= 0.0 mg/l)	N. A.	0.0 mg/l (1 sample)
Sub-McKay Coal													

Appendix B - Rosebud Mine Area Groundwater Quality Data From MDEQ Files

Aquifer	Se	Va Diss.	Zn Diss.	Bo Diss.
			0 to 2.09	
	0 to 0.18 mg/l (681 samples, median= 0.0 mg/l)	0 to 1.00 mg/l (675 samples, median= 0.0 mg/l)	mg/l (753 samples, median= 0.03 mg/l)	0 to 31.6 mg/l (247 samples, median= 0.40 mg/l)
Alluvium				
			0 to 4.67	
	0 to 0.07 mg/l (401 samples, median= 0.0 mg/l)	0 to 1.00 mg/l (399 samples, median= 0.0 mg/l)	mg/l (543 samples, median= 0.10 mg/l)	0 to 4.0 mg/l (152 samples, median= 0.40 mg/l)
McKay Coal				
			0 to 8.01	
	0 to 0.02 mg/l (317 samples, median= 0.0 mg/l)	0 to 1.21 mg/l (321 samples, median= 0.0 mg/l)	mg/l (500 samples, median= 0.06 mg/l)	0 to 4.60 mg/l (113 samples, median= 0.40 mg/l)
Rosebud Coal				
			0 to 17.20	
	0 to 0.09 mg/l (197 samples, median= 0.0 mg/l)	0 to 0.10 mg/l (195 samples, median= 0.0 mg/l)	mg/l (224 samples, median= 0.08 mg/l)	0 to 2.0 mg/l (81 samples, median= 0.40 mg/l)
Sub-McKay Coal				

APPENDIX C
WATER QUALITY DATA FROM THE DECKER MINE AREA, BIG HORN COUNTY, MONTANA

Appendix C - Decker Mine Area Water Quality Data From MDEQ

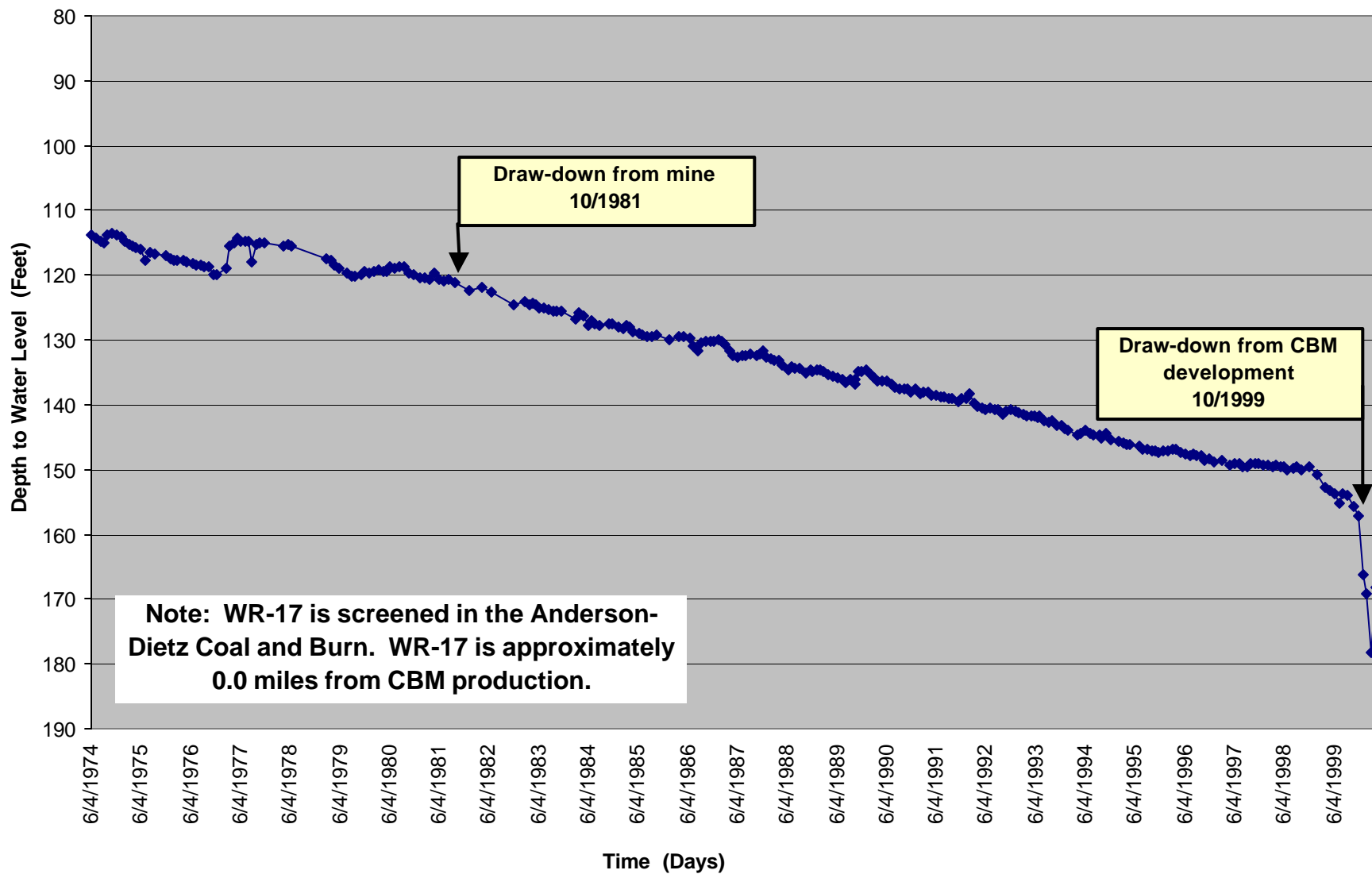
Aquifer	Number of Samples	Diss. Al	Diss. As	Diss. B	Diss. Ba	Diss. Ca	Diss. Cd	Diss. Cl	Diss. CO3	Diss. Cr	Diss. Cu	Diss. F	Diss. Fe	Diss. Bicarb .	Diss. Hg	Diss. K	Diss. Mg	Diss. Mn
Alluvium	42	0 to 0.15 mg/l	0 to 0.002 mg/l	0 to 1.03 mg/l	0 to 0 mg/l	158 to 269 mg/l	0 to 0.005 mg/l	16 to 37 mg/l	0 mg/l	0 to 0.06 mg/l	0 to 0.01 mg/l	0.2 to 6.11 mg/l	0 to 0.49 mg/l	522 to 635 mg/l	0.0 mg/l	4.2 to 23.6 mg/l	165 to 263 mg/l	0 to 0.19 mg/l
Anderson	82	0 to 16.8 mg/l	0 to 0.0 mg/l	0.0 to 0.85 mg/l	0 to 0.06 mg/l	1.6 to 20.0 mg/l	0 to .004 mg/l	6 to 140 mg/l	0 to 70 mg/l	0 to .05 mg/l	0 to 0.12 mg/l	0.49 to 4.44 mg/l	0 to 1.81 mg/l	394 to 2010 mg/l	0.0 mg/l	1.0 to 37.8 mg/l	0.35 to 13.0 mg/l	0 to 0.47 mg/l
Dietz	261	0 to 6.3 mg/l	0 to 0.014 mg/l	0 to 1.73 mg/l	0 to 1.49 mg/l	2 to 236 mg/l	0 to 0.013 mg/l	1.7 to 89 mg/l	0 to 137 mg/l	0 to 0.03 mg/l	0 to 0.06 mg/l	0.22 to 18 mg/l	0 to 6.74 mg/l	0 to 2360 mg/l	0 to 0.003 mg/l	0 to 25 mg/l	0 to 454 mg/l	0 to 1.8 mg/l
Canyon	54	0 to 1.2 mg/l	0.0 mg/l	0 to 0.73 mg/l	0 to 1.4 mg/l	3 to 36 mg/l	0 to 0.003 mg/l	3.3 to 31 mg/l	0 to 240 mg/l	0.0 mg/l	0 to 0.02 mg/l	1.65 to 5.14 mg/l	0 to 0.78 mg/l	1189 to 2172 mg/l	0.0 mg/l	3.7 to 17.3 mg/l	0 to 85 mg/l	0 to 0.11 mg/l

Appendix C - Decker Mine Area Water Quality Data From MDEQ

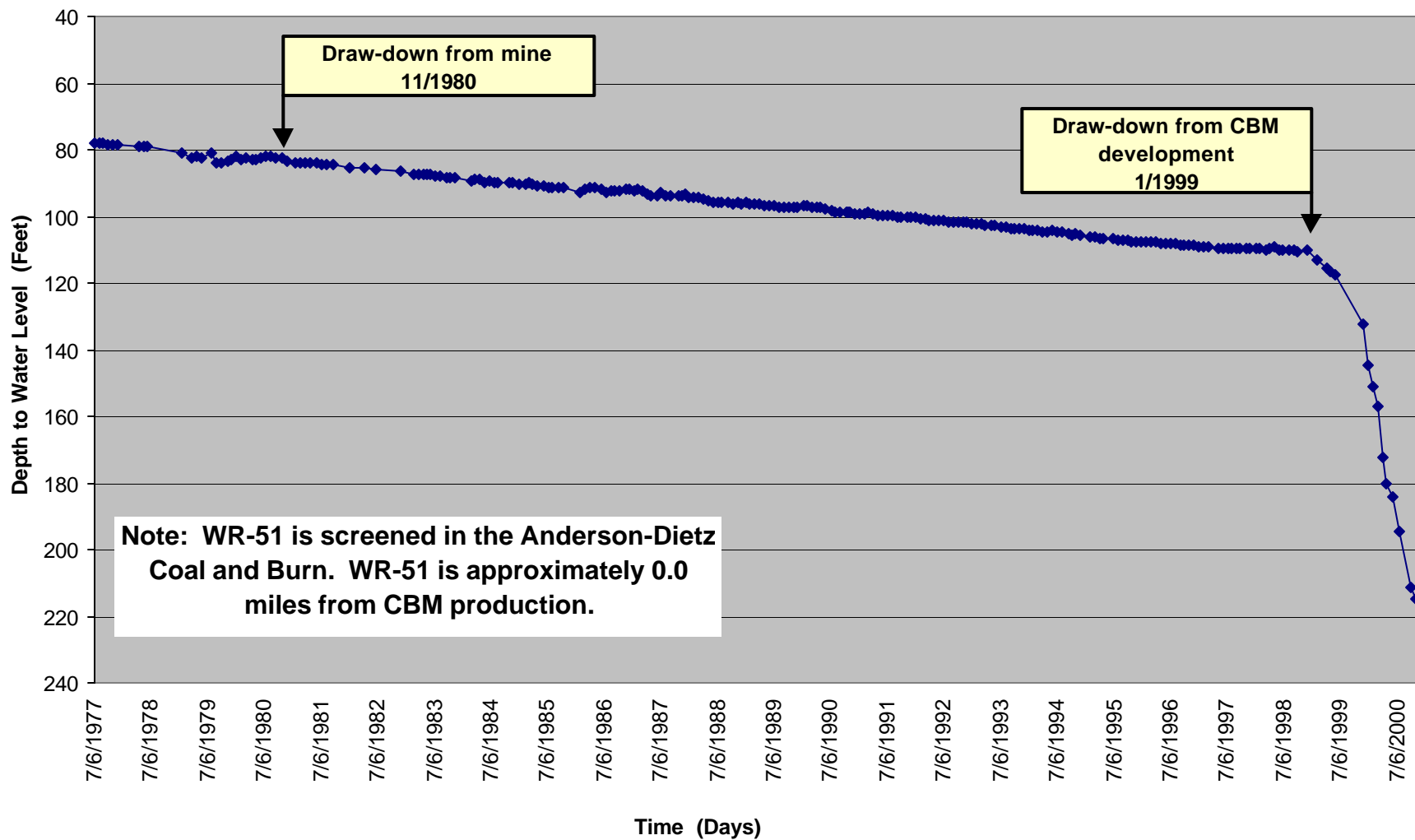
Aquifer	Nitrate										TDS (dried)
	Diss Mo	Diss. Na	NH3	Diss. Ni	+ Nitrite	Diss. Pb	Diss. Se	Diss. SO4	Diss. Zn	SAR	
Alluvium	0 to 0.05 mg/l	552 to 750 mg/l	0 to 0.79 mg/l	0 to 0.18 mg/l	0.1 to 1.49 mg/l	0.0 mg/l	0 to 0.005 mg/l	to 2552 mg/l	0 to 1.36 mg/l	0.3 to 8	3420 to 4340 mg/l
Anderson	0 to 0.05 mg/l	145 to 1036 mg/l	0 to 27.8 mg/l	0 to 0.08 mg/l	0 t 10.27 mg/l	0 to 0.04 mg/l	0 to 0.005 mg/l	0 to 663 mg/l	0 to 0.32 mg/l	8 to 77	502 to 3400 mg/l
Dietz	0 to 0.08 mg/l	44 to 987 mg/l	0 to 8.91 mg/l	0 to 0.15 mg/l	0 to 3.72 mg/l	0 to 0.02 mg/l	0 to 0.01 mg/l	0 to 3690 mg/l	0 to 1.04 mg/	1 to 131	430 to 6520 mg/l
Canyon	0 to 0.02 mg/l	451 to 863 mg/l	0 to 4.36 mg/l	0 to 0.04 mg/l	0 to 3.47 mg/l	0 to 0.01 mg/l	0.0 mg/l	0 to 672 mg/l	0 to 0.86 mg/l	14 to 72	1060 to 2860 mg/l

APPENDIX D
SELECTED HYDROGRAPHS IN THE AREA OF CX RANCH, BIG HORN COUNTY, MONTANA

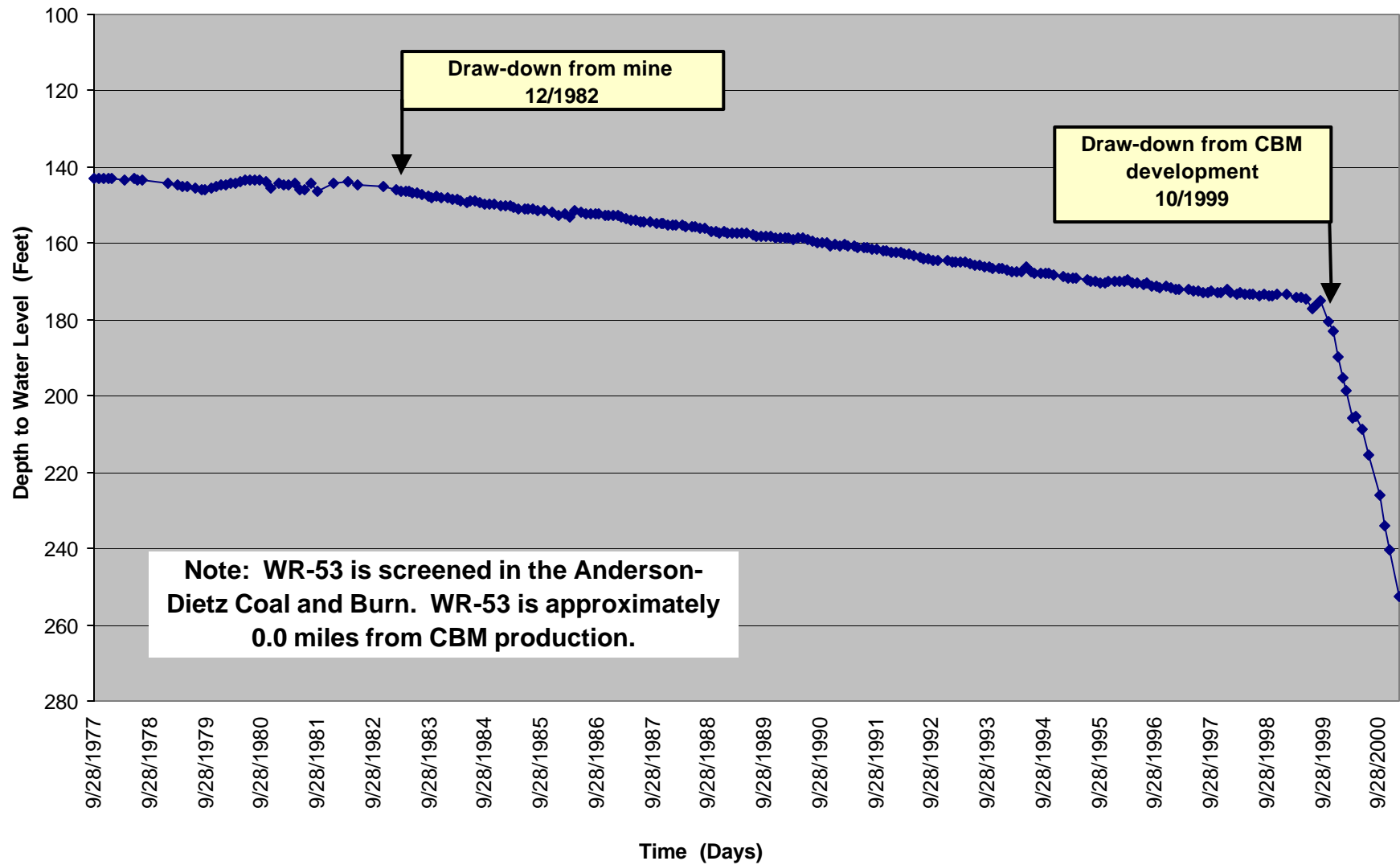
Water Resources Impact Analysis Montana CBM Technical Report



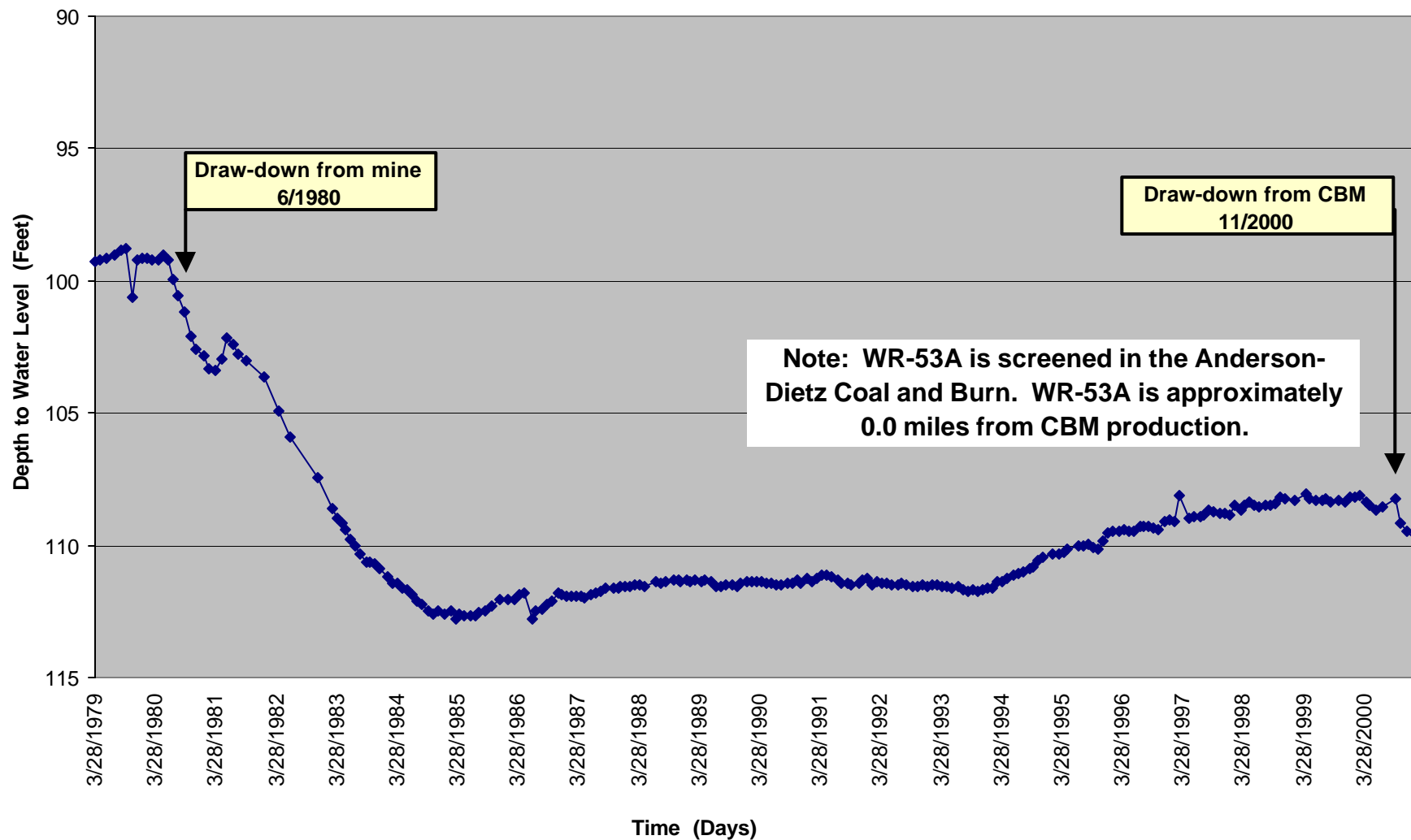
Water Resources Impact Analysis Montana CBM Technical Report



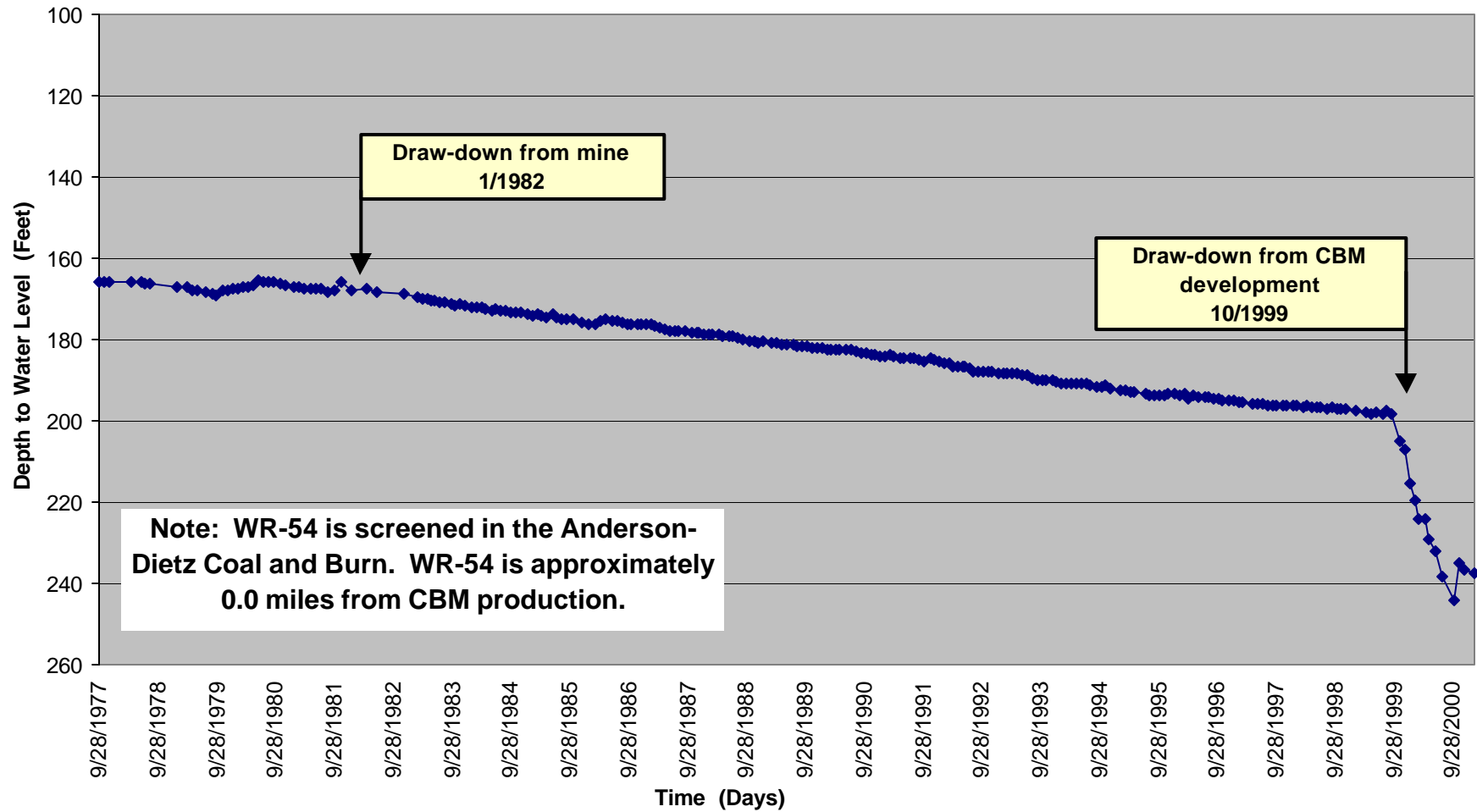
Hydrograph: Well #WR - 53



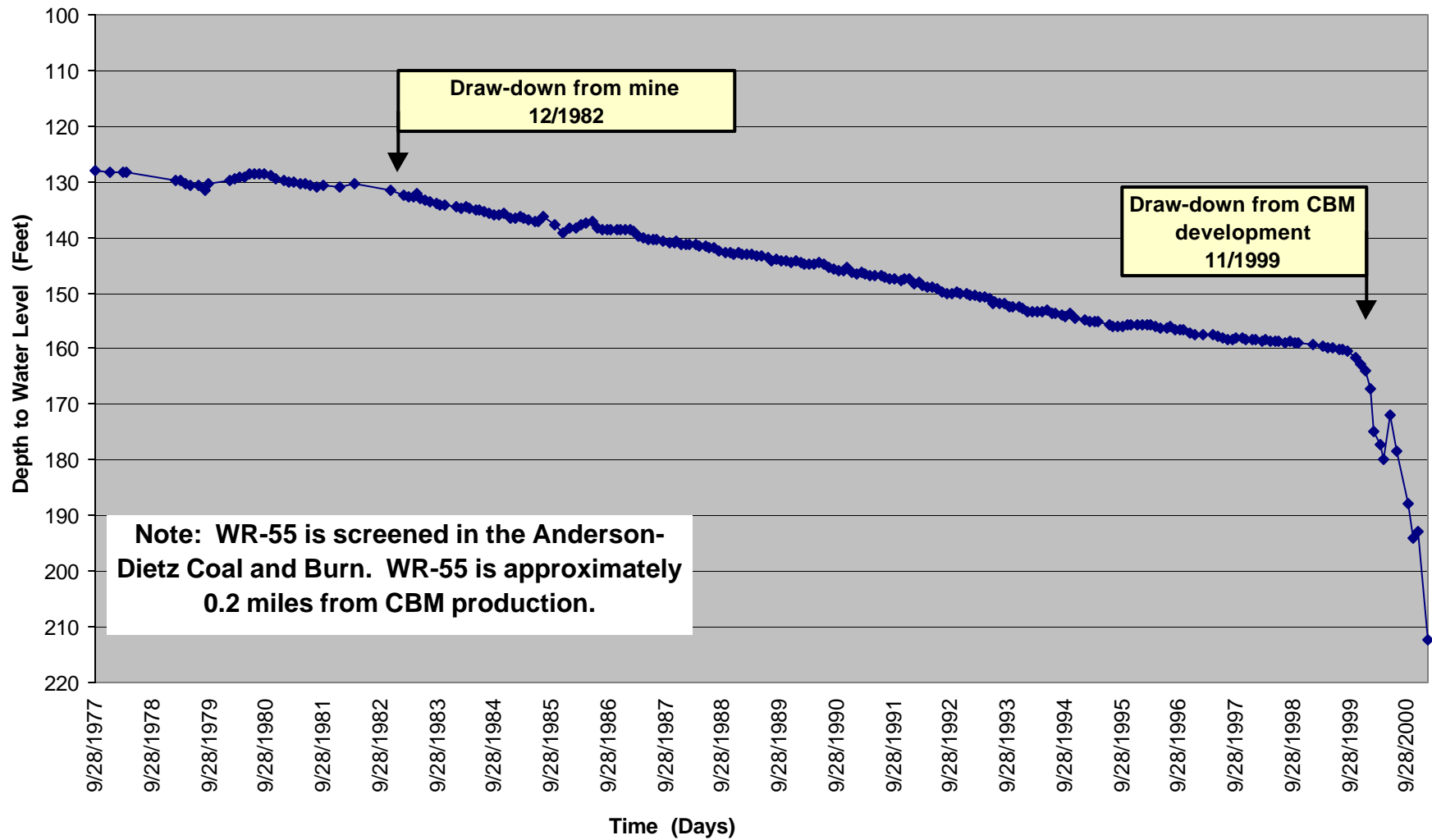
**Water Resources Impact Analysis
Montana CBM Technical Report**



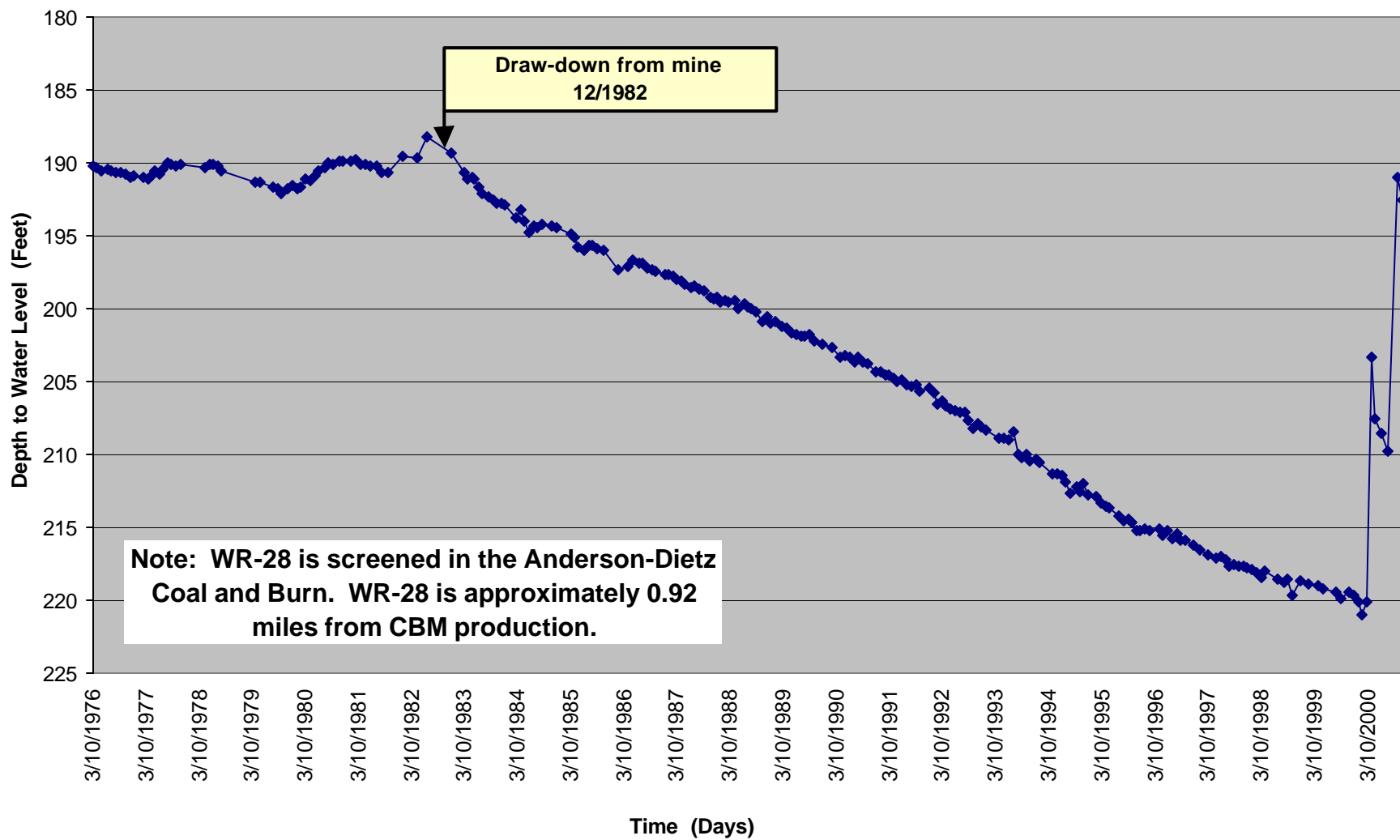
Water Resources Impact Analysis Montana CBM Technical Report



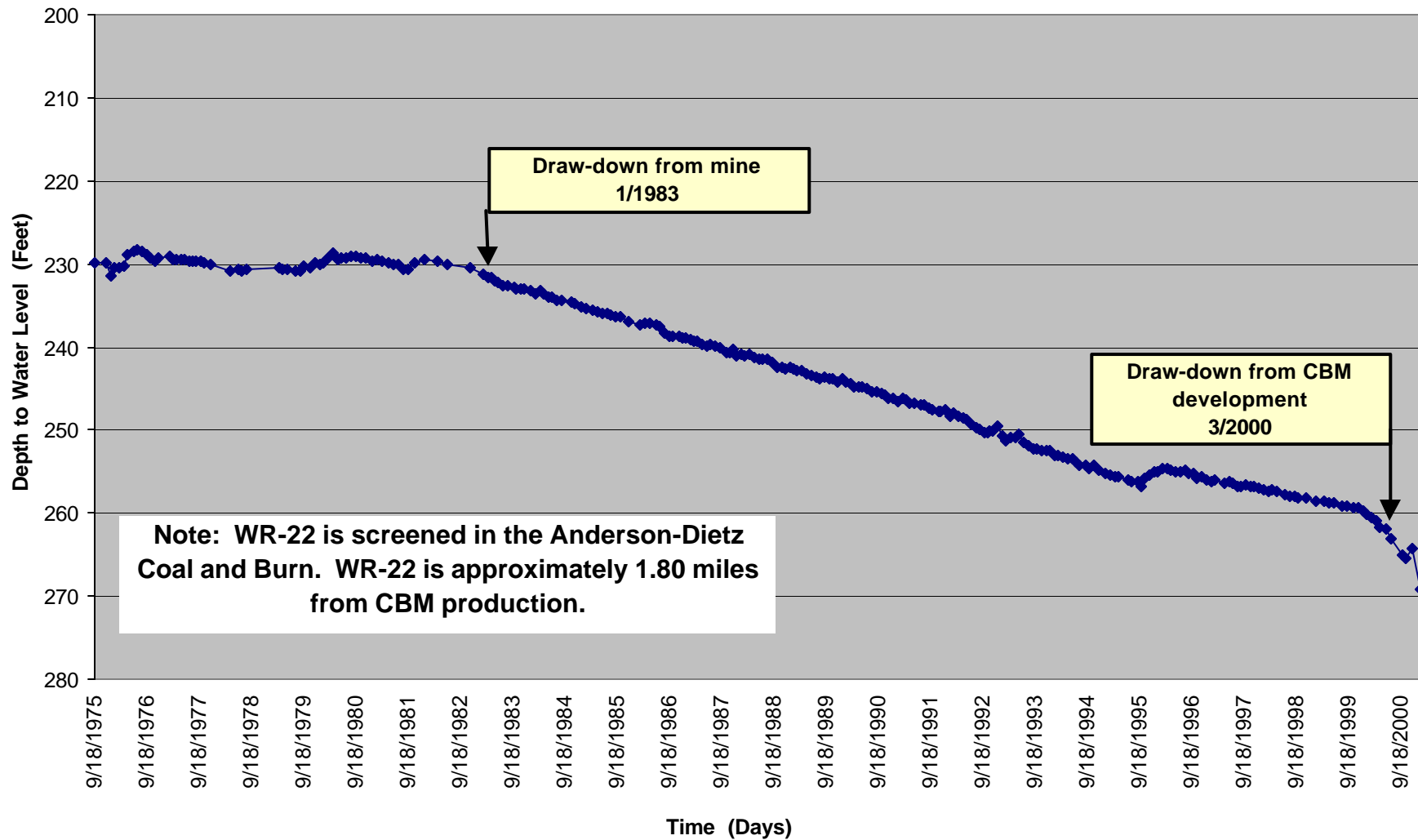
**Water Resources Impact Analysis
Montana CBM Technical Report**



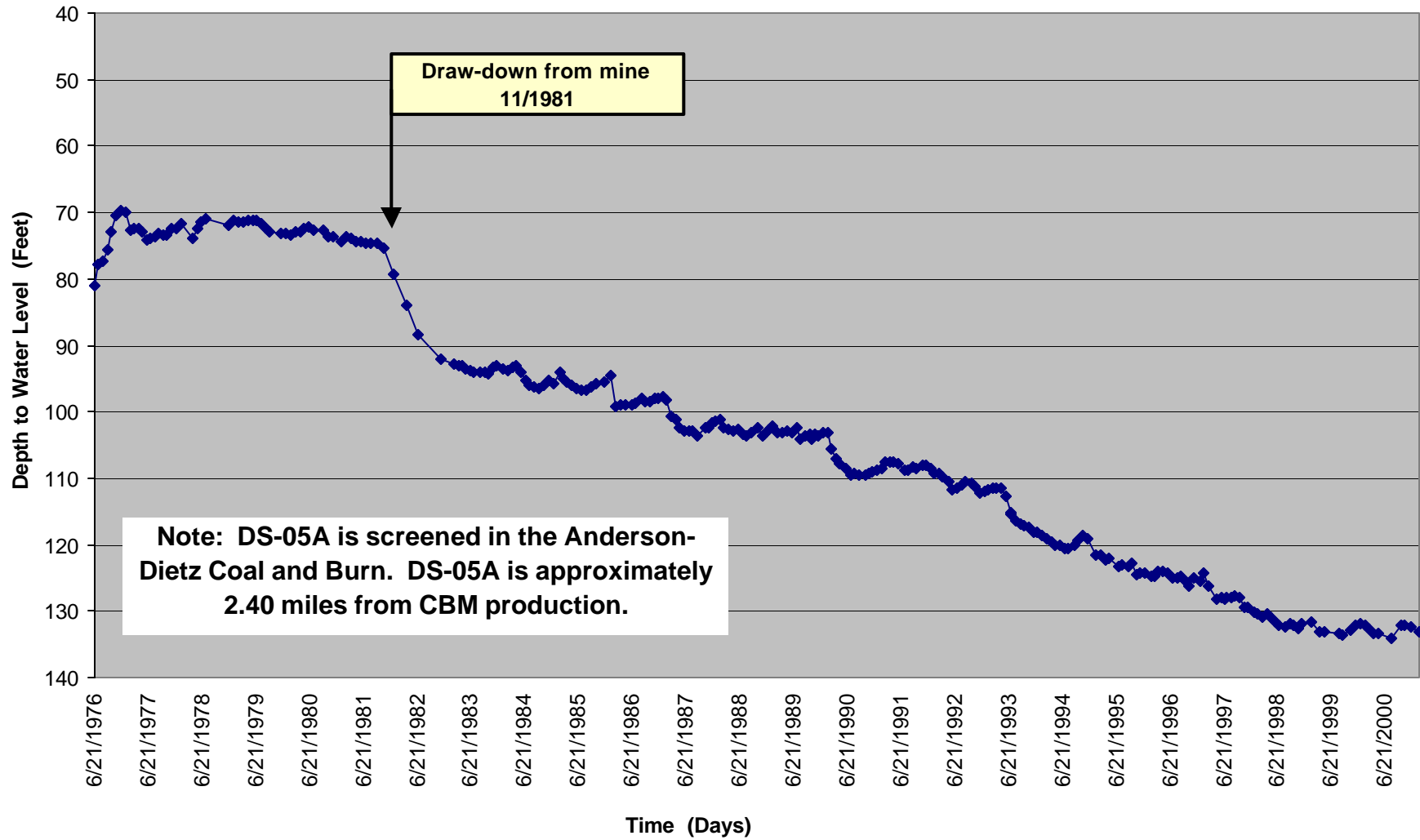
**Water Resources Impact Analysis
Montana CBM Technical Report**



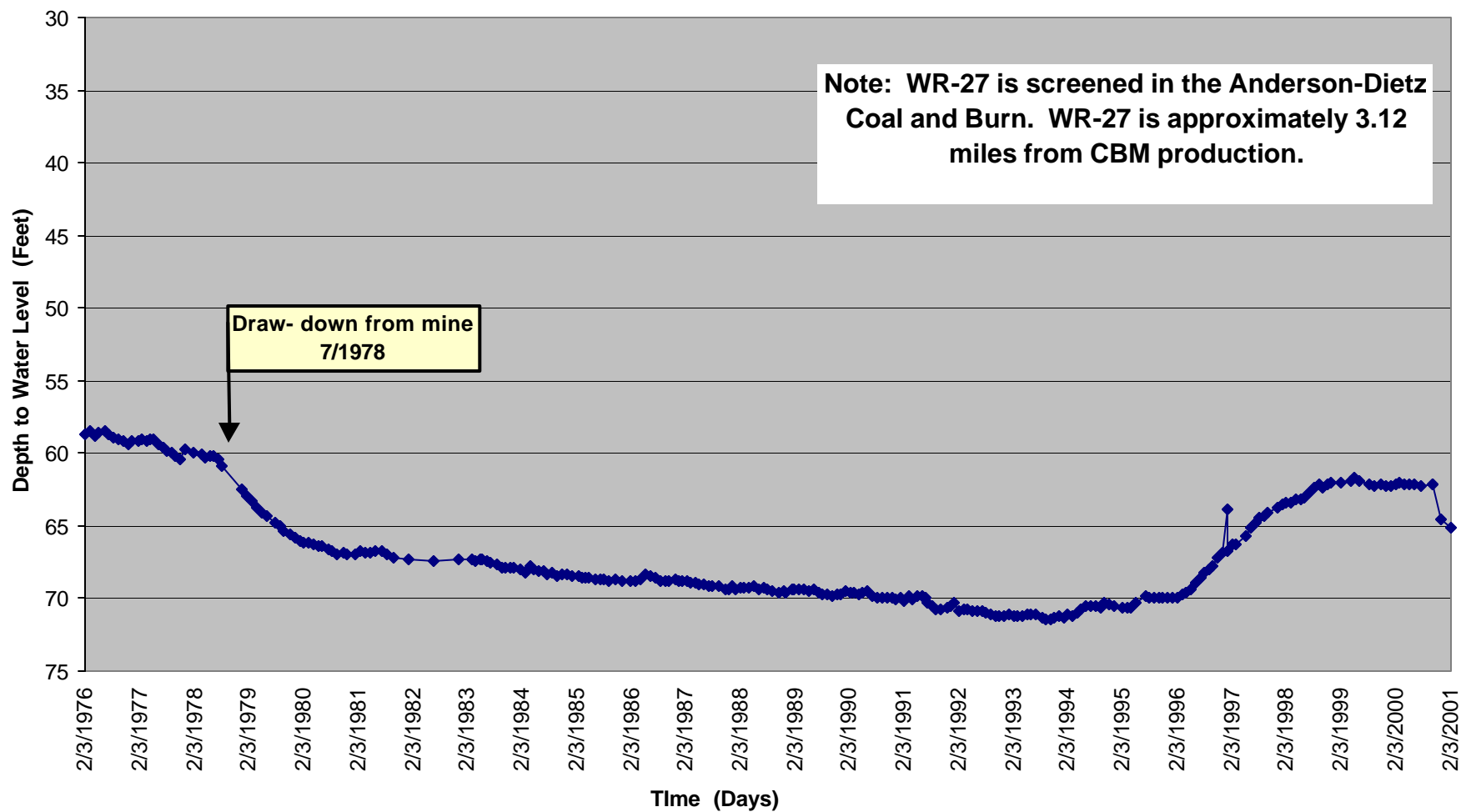
**Water Resources Impact Analysis
Montana CBM Technical Report**



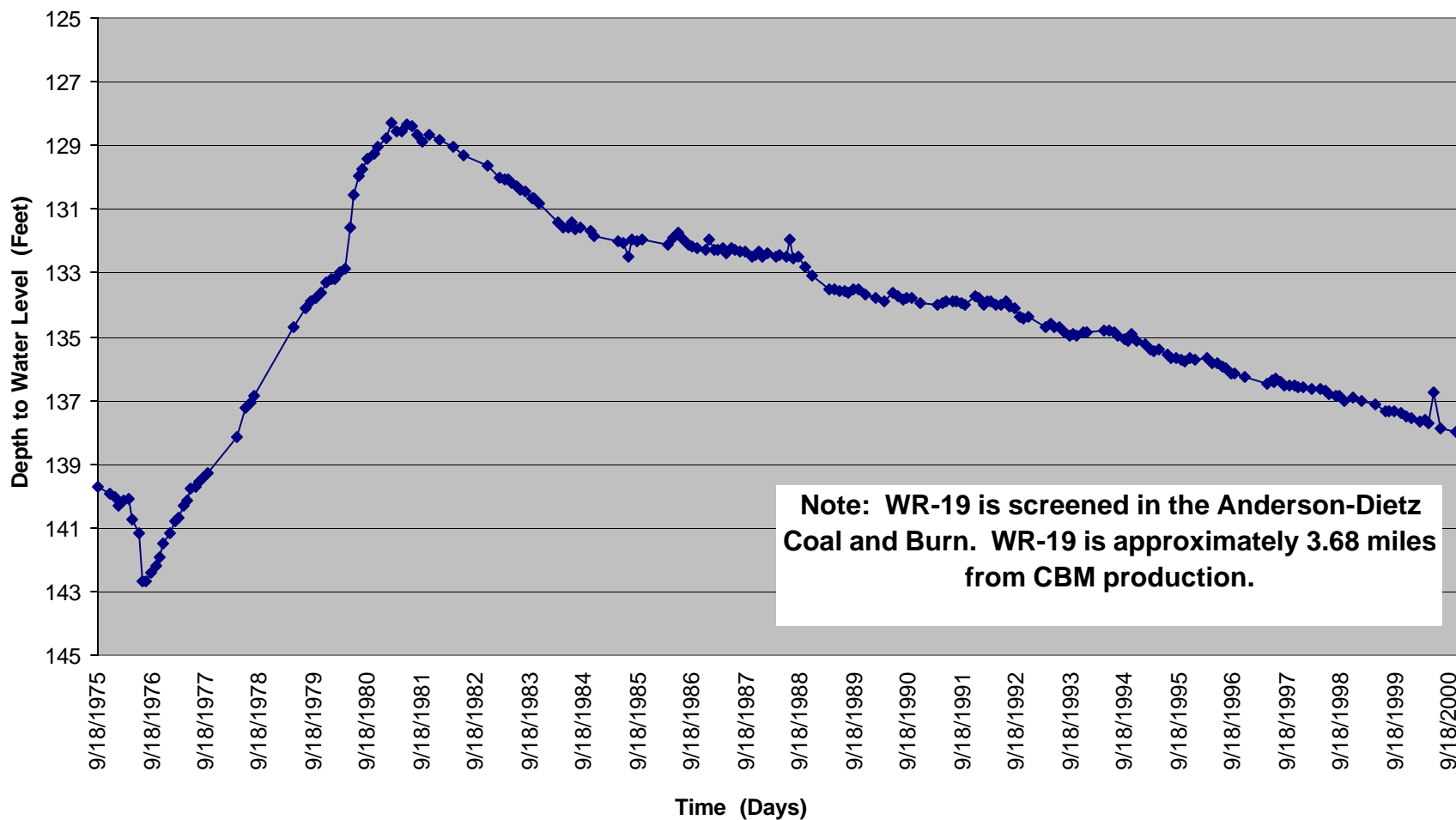
**Water Resources Impact Analysis
Montana CBM Technical Report**



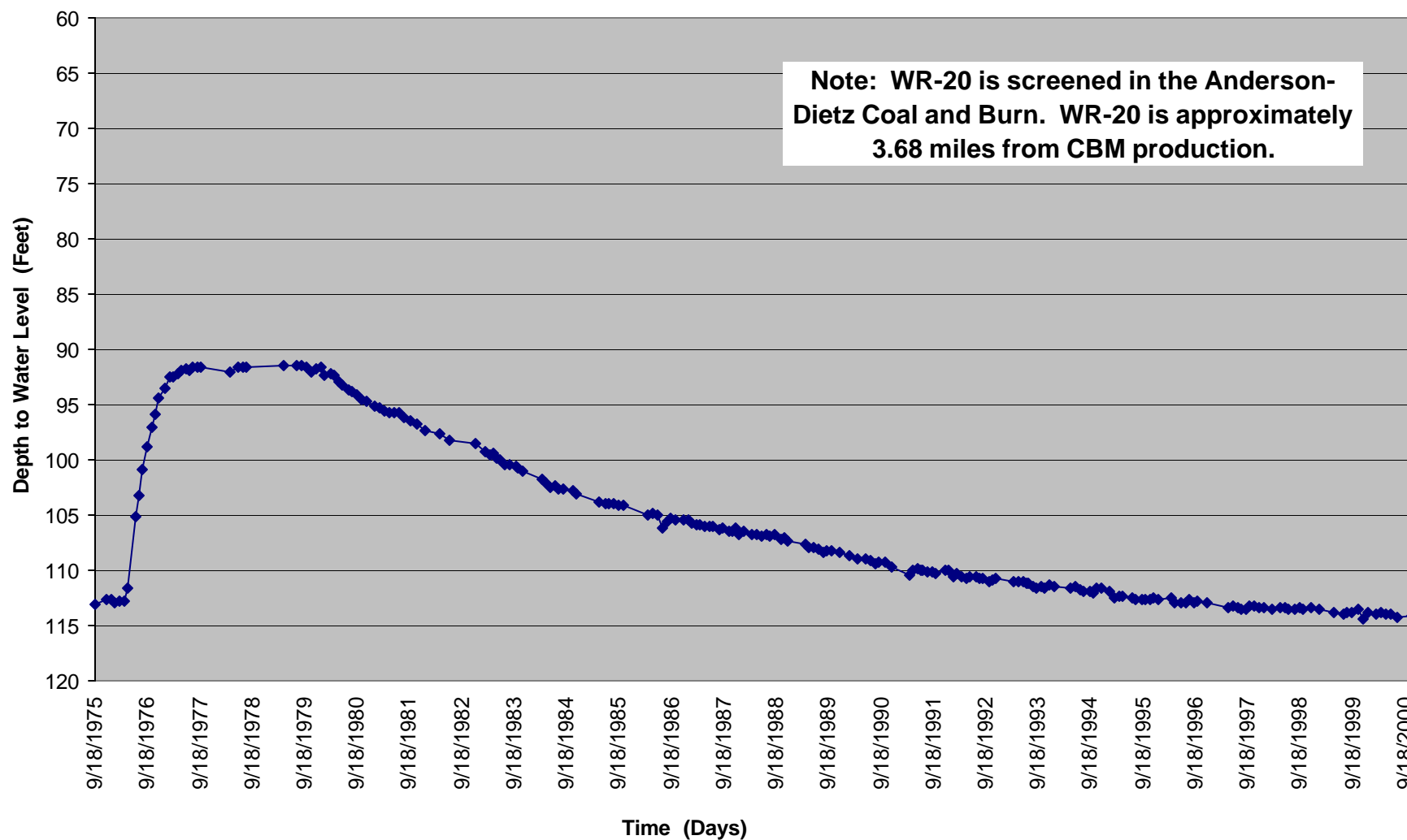
**Water Resources Impact Analysis
Montana CBM Technical Report**



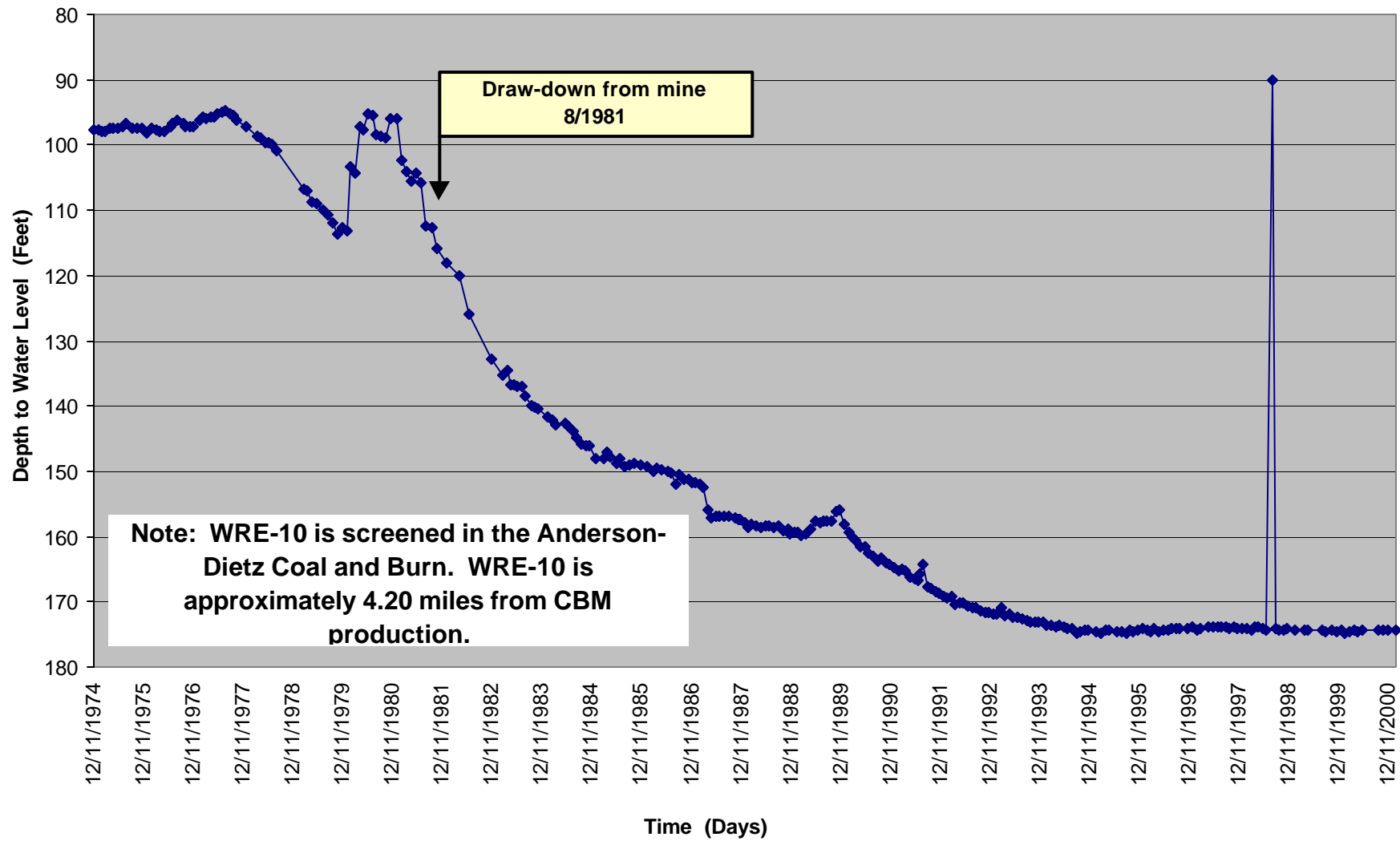
Water Resources Impact Analysis Montana CBM Technical Report



**Water Resources Impact Analysis
Montana CBM Technical Report**



Water Resources Impact Analysis
Montana CBM Technical Report



APPENDIX E
FINAL ORDER IN THE MATTER OF THE DESIGNATION OF THE POWDER RIVER BASIN
CONTROLLED GROUNDWATER AREA

FINAL ORDER

**IN THE MATTER OF THE DESIGNATION OF THE POWDER RIVER BASIN
CONTROLLED GROUNDWATER AREA**

**BEFORE THE DEPARTMENT OF
NATURAL RESOURCES AND CONSERVATION
OF THE STATE OF MONTANA**

FINAL ORDER

**IN THE MATTER OF THE DESIGNATION OF THE POWDER RIVER BASIN
CONTROLLED GROUNDWATER AREA**

Pursuant to the Montana Water Use Act, Mont. Code Ann. § 85-2-506, and after notice required by law, public hearings were held on September 22 and 23 in Lodge Grass, Colstrip, Miles City, and Broadus to consider the Montana Department of Natural Resources and Conservation's proposal to designate a controlled groundwater area for the Powder River Basin in anticipation of expected groundwater withdrawals associated with coal bed methane development in the area. Comments were accepted into the record at the hearings and written comments were accepted through October 8, 1999. Based on the information gathered by the Department, the input of other agencies, and the public comment received the Department has modified its proposed findings, conclusion, and order as will follow. The public comment is addressed in the Memorandum that appears at the end of this order.

FINDINGS OF FACT

1. Coal bed methane extraction technology requires groundwater withdrawal to lower groundwater levels and reduce water pressures in the coal beds. Wells may be placed at regular intervals over large areas covering many square miles. The wells are pumped continuously with the specific intent of lowering water pressures in the coal bed. Lowering water pressures will lower water levels in the aquifer.
2. During coal bed methane development, water is removed only from coal aquifers. Other aquifers in an area in a coal bed methane development area may or may not be affected depending upon connections between aquifers.

3. Coal beds are important regional aquifers in water-scarce southeastern Montana. The coal aquifers are often the only practical source of fresh water for domestic, stock, and agricultural uses by the people in the area.
4. The complexities of geology and hydrogeology and the uncertainty about the extent and precise location of future coal bed methane development do not allow an accurate assessment of conflicts with existing and future beneficial water use. However, there is considerable data available showing significant effects on water levels in coal aquifers from extensive and continuous pumping of water from coal mines in the Decker area.
5. Since coal bed methane development is of limited duration, 20 to 30 years, in any particular field, and because the aquifer is not otherwise disturbed, water in the aquifer most likely will recover to its pre-development level. However, even if an aquifer were to recover rapidly after development, the long period of development could cause severe hardship to local water users. Moreover, interrelationships among aquifers along with future precipitation patterns could cause unpredictable results.
6. Assessment of localized effects of coal bed methane development on water availability would require compiling baseline data from existing wells, before methane gas development, along with data from test wells and coal bed methane production wells. Monitoring of water levels, water pressures and pumping rates during development would also be necessary to determine the effects.
7. The Department of Natural Resources and Conservation usually considers a one-half mile radius from any particular water well as the zone of possible influence from the well. When the Department receives an application for a water well the owners of all existing wells within that radius are notified. Available information does not justify an assumption that wells for coal bed methane development should be considered any different. However, neither does the information justify any assumption that wells or springs over a half a mile from coal bed methane development will not be affected. Baseline information should be gathered for any well within the general location of coal bed methane development so that the effects can be monitored.
8. Although withdrawing groundwater is integral to the coal bed methane extraction method, water is not a desired product of the operation, and must be disposed. Since the withdrawal of the water is not a use of the water per se, a water use permit from the DNRC is not required for withdrawing the water. Public authorities do not otherwise regulate the withdrawal of ground water in the area except as it relates to coal mining.
9. Water withdrawn during coal bed methane withdrawal may be suitable for use by local residents, agriculture, and business. Wells drilled for coal bed methane development could in some cases be developed as water sources for local residents, agriculture, and business.
10. Wells that are inadequately sealed present a hazard of contaminating water in one aquifer with contaminants from another aquifer or introducing methane into non-coal aquifers. The Board of Oil and Gas Conservation regulates well construction and enforces standards for sealing gas wells. These standards are in excess of the

standards of sealing water wells enforced by the Montana Board of Water Well Contractors.

11. Since water withdrawn from the aquifers is not otherwise consumed, the water must be discharged in some manner. Any applicable water discharge permits must be obtained, and water disposal requirements must be met, before groundwater may be discharged, re-injected, or disposed in the Controlled Groundwater Area. Water discharge permits may include the Montana Pollutant Discharge Elimination System (MPDES) permit from the Department of Environmental Quality (DEQ), for discharge to surface water, and the Underground Injection Control (UIC) permit from the Board of Oil and Gas Conservation, for discharge re-injected to groundwater.
12. Extensive coal bed methane development has occurred from coal-bearing strata within the Powder River Basin geologic structure in Wyoming and some development has occurred in Montana near Decker. The Powder River Basin geologic structure and associated coal-bearing strata extends north into southeastern Montana. Consequently, coal bed methane development will likely extend further north into southeastern Montana in the near future.
13. The proposed controlled groundwater area includes the Wasatch Formation and the Tongue River Member of the Fort Union Formation. The formations are the two principle coal-bearing strata in southeastern Montana. The area forms a generally contiguous block of these coal-bearing formations within the Montana part of the Powder River Basin (see Map 1). According to the Montana Bureau of Mines and Geology (MBMG), the area includes all known strippable sub-bituminous coal deposits greater than 30 inches thick in southeastern Montana. (MBMG SP28, Figure 10).
14. Montanans have a right to a clean and healthful environment.

CONCLUSIONS OF LAW

1. Excessive groundwater withdrawals are very likely to occur in the near future because of consistent and significant increases in withdrawals from within the area proposed for controlled ground water designation. By "excessive", the Department means that water levels in targeted aquifers could be reduced near project areas for long periods of time in a water-scarce area.
2. The public health, safety, and welfare require that such extensive water withdrawals in a water-scarce area are monitored and the water withdrawals be controlled where existing beneficial uses of water are adversely affected. Without this designation of a controlled ground water area the extensive withdrawals of ground water anticipated may proceed uncontrolled.
3. With this designation of a controlled groundwater area the withdrawal of groundwater associated with coal bed methane production will be under the prior jurisdiction of the Montana Board of Oil and Gas. However, water rights matters and hydrogeologic issues are not within the ordinary technical expertise and area of concern to the Board. These are matters ordinarily dealt with by the Montana

Department of Natural Resources and Conservation and the Montana Bureau of Mines and Geology. The Montana Department of Natural Resources may petition the Board for hearings in regard to the production, use, and disposal of water from coal bed methane development wells that could effect existing water rights in the area based upon information gathered concerning water withdrawals.

4. This controlled groundwater designation will not affect regulation of new water rights for conventional water uses. If local interests wish to acquire water rights to wells constructed during coal bed methane development, a beneficial use permit will be required. Standard exceptions to permit requirement will still apply. For example, a permit will not be required for appropriations of 35 gallons per minute or less and not exceeding 10 acre-feet per year on wells developed for beneficial use. Laws for ground water withdrawals that do not require a water use permit such as conventional oil and gas activities, mining, or agricultural drainage, will remain in effect as in other parts of the state.
 5. Discharges of water during coal bed methane development, and well sealing to prevent leakage and contamination are sufficiently regulated by the DEQ and Board of Oil and Gas.
-
6. The designation of a controlled groundwater area does not infringe on the rights of Montana citizens to a clean and healthful environment.

ORDER

The following described area, as also delineated on Map 1 attached, is designated a Controlled Groundwater Area under Mont. Code Ann. § 85-2-506: all sections in Township 06N, Ranges 45E and 46E; all sections in Township 05North, Ranges 40East – 47 East; all sections in Township 04 North, Ranges 38 East, 39 East, 41East – 46 East, and 48 East; all sections in Township 03 North, Ranges 37 East – 49 East; all sections in Township 02 North, Ranges 36 East – 50 East; all sections in Township 01North, Ranges 36 East – 50 East; all sections in Township 01 South, Ranges 37 East – 50 East; all sections in Township 02 South, Ranges 37 East – 51 East; all sections in Township 03 South, Ranges 37 East – 51 East; all sections in Township 04 South, Ranges 37 East – 51 East; all sections in Township 05 South, Ranges 36 East – 50 East; all sections in Township 06 South, Ranges 36 East – 51 East; all sections in Township 07 South, Ranges 37 East – 51 East; all sections in Township 08 South, Ranges 37 East – 51 East; and all sections in Township 09 South, Ranges 37 East – 51

East. The controlled groundwater area includes all formations above the Lebo member of the Fort Union Formation.

1. Applicability to coal bed methane wells only.

This controlled groundwater area designation shall apply only to wells designed and installed for the extraction of coal bed methane (CBM).

2. Standards for Permitting, Drilling, and Producing Coalbed Methane Wells

CBM development within the controlled groundwater area must follow the standards for drilling, completing, testing, and production of CBM wells as adopted by the Board of Oil and Gas Conservation. Standards include: field development proposals including initial test wells and development plans; maps of the targeted coal bed; an inventory and hydrologic assessment of existing wells, springs, and streamflow that could be impacted by the operation; and means to mitigate water resource impacts. The Board of Oil and Gas Conservation shall consider applications for each coal bed methane production field. Approval of specific field rules may include requirements and restrictions in addition to the general operating standards.

3. Water Source Mitigation Contract

Coal bed methane operators must offer water mitigation agreements to owners of water wells or natural springs within one-half mile of a CBM field proposed for approval by the Board or within the area that the operator reasonably believes may be impacted by a CBM production operation, whichever is greater. This area will be automatically extended one-half mile beyond any well adversely affected. The mitigation agreement must provide for prompt supplementation or replacement of water from any natural spring or water well adversely affected by the CBM project and shall be under such conditions as the parties mutually agree upon. Mitigation agreements are intended to address the reduction or loss of water resources and may exclude mechanical, electrical, or similar loss of productivity not resulting from a reduction in the amount of available water due to production from CBM wells. The areas covered by mitigation agreements will be considered in review of field development proposals. The TAC will make recommendations to the Board of Oil and Gas Conservation if it identifies a need to increase the required mitigation area.

4. Technical Advisory Committee

The DNRC will designate a Technical Advisory Committee (TAC) with specific expertise in coal aquifer hydrology and shallow groundwater systems. The committee will oversee the groundwater characteristics and monitoring, and the reporting requirements identified in items 5 and 6 below. The TAC will also review groundwater data and scientific evidence related to the Powder River Basin Controlled Groundwater Area and advise the agencies on administration of the area.

The committee will consist of qualified scientists with experience related to the hydrogeology of coal aquifers and CBM extraction operations. The appointments and selections shall be to ensure, to the extent possible, that the committee includes members with expertise in hydrogeology, water quality, and CBM extraction systems and operations.

The TAC will periodically review groundwater data gathered from CBM development. This TAC will prepare an annual report each year, of their findings regarding the impact to the groundwater resource from CBM activities and any mitigation recommendations they may develop. The TAC may submit reports more often if they find it appropriate. Additionally, the TAC will make recommendations to the Board of Oil and Gas Conservation regarding development of specific groundwater characterization, monitoring, and reporting requirements for field developments.

5. Groundwater Characterization, Monitoring, and Reporting

Hydrologic conditions in the targeted coal beds must be assessed prior to field development to establish baseline conditions. Specific requirements of the field rules will dictate that groundwater pressure is monitored in appropriate locations using dedicated monitoring wells, and that groundwater monitoring and reporting is conducted in a manner consistent with the recommendations outlined in the attached memorandum (Attachment A). In addition to all forms required by the Board of Oil and Gas Conservation Completion, a Montana Well Log Report, DNRC Form 603, must be completed for both production and monitoring wells when the wells are drilled and sent to DNRC at the address on the form within 60 days of the well completion.

The specific requirements for each production field will be developed with consideration of recommendations from the TAC. The procedures will include dedicated groundwater monitoring wells outside of, and surrounding the production field. The operator will be required to seek landowner approval to install such wells at appropriate distances from the field. State or federal lands should be considered. If the operator demonstrates that

no site is available at appropriate distance, a well at the extreme outer limit of the operator's lease area may suffice. Dedicated groundwater monitoring wells must be placed in the next aquifer above and below the targeted coal seam, if applicable, within the production field. Also, as a minimum requirement, at least one 24-hour aquifer test must be conducted using at least one observation well, and baseline groundwater pressures and water quality data must be obtained from the monitoring wells prior to production.

6. Data Collection and Notice Procedures

Data collected from testing and production of CBM wells and any groundwater monitoring wells and springs required by the Board of Oil and Gas Conservation will be available to the public and provided to the Montana Bureau of Mines and Geology. The Board of Oil and Gas Conservation will notify DNRC of applications relating to CBM field development proposals so that the Department may supply a mailing list of potentially affected water right holders within one-half mile of the proposed field area. The Board will publish notice in accordance with its existing procedures and will additionally require the developer to send individual notices to the water right holders listed by the DNRC.

NOTICES

1. Precautions in Coalbed Methane Areas

Water well developers and drillers must exercise caution when drilling water wells in or near coal bed methane projects as free methane gas may be encountered in one or more coal beds. Drillers should contact the Board of Oil and Gas Conservation Office at (406) 656-0040 for information about coal bed methane activities in their area of interest.

2. Beneficial Use of Water

Beneficial uses of water produced from CBM operations, such as for stock ponds, wildlife ponds, or irrigation requires a water right issued by DNRC as provided by law.

3. Water Discharge and Re-injection

The DEQ Water Protection Bureau at (406) 444-3080 administers the Montana

Pollution Discharge Elimination System permit. The Board of Oil and Gas Conservation at (406) 656-0040 administers the Underground Injection Control permit.

Dated this _____ day of December 1999.

Arthur Clinch, Director
Dept of Natural Resources and Conservation
1625 Eleventh Avenue
Helena, Montana 59620
(406) 444-2074

MEMORANDUM

The public hearings on the establishment of the Powder River Basin Controlled Groundwater Area were well attended and the Water Resources Division received substantial written comment. The public comment was unanimous in its concern that scarce water resources and existing water uses in the area be protected and overwhelmingly favored establishing a controlled groundwater area. The only dissent to the DNRC proposal did not object so much to the underlying goal of protecting the groundwater resource, but was more concerned that existing regulation was being duplicated.

Local public support for a controlled groundwater area is critical. The Powder River Basin situation is unique in its vast area, its water scarcity, the volume of withdrawals contemplated, and the immediacy of those withdrawals. The DNRC therefore initiated the process for establishing the area on its own motion rather than waiting for a local petition. If, however, it had appeared during the information-gathering period that the public was not interested in or did not favor establishing the area, the DNRC would not have gone forward with the proposal. After all, it is local water users that a controlled groundwater area is designed to protect.

The comment generally expressed concerns about a lack of information about the possible impacts of, and lack of government control and coordination over, water withdrawals and discharges during coal bed methane development. The DNRC has attempted to address these concerns with the modified findings, conclusion, and order.

The most important component of the modified order is the requirement to record and gather baseline and monitoring data so that problems and impacts can be detected as they occur. Of equal importance may be the establishment of a technical advisory committee to review, analyze, and make recommendations concerning the information gathered. The technical advisory committee can also review information provided by local water users. Judging from the public comment, the local land owners will be more than willing to provide any information they might have that will help the committee to track the impacts of the water withdrawals. Without such information and review, attempts to mitigate any adverse impact and to implement any necessary control over the development would be difficult. Individual water users generally do not have the resources to put together the information required to implement controls or mitigate impacts.

The modified order has also attempted to address concerns about the lack of coordination and duplication of regulation between government agencies. For example, the modified order recognizes the jurisdiction of the Montana Department of Environmental Quality over water discharges. The public comments expressed grave concern about the quality of the water and the DEQ has been apprized of that concern. The DNRC, however, will not be regulating in that area. It has also been determined that the Montana Board of Oil and Gas already has sealing standards for wells that will protect aquifers from contamination so that there is no reason to apply such standards as a condition of the controlled groundwater area.

One notable addition to the findings and conclusions concerns a Montana citizen's right to a clean and healthful environment guaranteed by Article II, Section 3 of the Montana Constitution. A recent Montana Supreme Court Decision, *Montana Environmental Information Center et al. v. Department of Environmental Quality*, 1999 MT 248, holds that the right to a clean and healthful environment is fundamental. Since water is vital, it would seem then that the Department would be remiss not to consider the environmental implications of establishing this controlled groundwater area. The Department believes that establishing the area will not intrude on the right to a clean and healthful environment, but rather will help to establish a means by which that right can be protected.

In conclusion, the DNRC was gratified by the interest and support expressed for the controlled groundwater area. When the community center in Broadus is filled to capacity

and a petition with over 150 signatures from that sparsely populated area is submitted it cannot be ignored. The DNRC will reciprocate by keeping the public informed of all developments. The DNRC also appreciates the attendance by Redstone Gas Partners at each of the public meetings and the cooperation they have shown throughout this process. The DNRC has considered the comments of all the participants and those comments have entered into the fashioning of this final order.

CERTIFICATE OF SERVICE

This certifies a true and correct copy of the Final Order was served upon all parties on the attached lists this ____ day of December 1999.

APPENDIX F
MBOGC BOARD ORDER 99-99

MBOGC BOARD ORDER 99-99

IN THE MATTER OF THE BOARD'S OWN MOTION FOR
AN ORDER ESTABLISHING COAL BED METHANE
OPERATING PRACTICES WITHIN THE POWDER RIVER
BASIN CONTROLLED GROUNDWATER AREA IN BIG
HORN, POWDER RIVER, ROSEBUD, TREASURE AND
CUSTER COUNTIES, MONTANA.

BEFORE THE BOARD OF OIL AND GAS CONSERVATION

OF THE STATE OF MONTANA

IN THE MATTER OF THE BOARD'S OWN MOTION FOR
AN ORDER ESTABLISHING COAL BED METHANE
OPERATING PRACTICES WITHIN THE POWDER RIVER
BASIN CONTROLLED GROUNDWATER AREA IN BIG
HORN, POWDER RIVER, ROSEBUD, TREASURE AND
CUSTER COUNTIES, MONTANA.

ORDER NO 99-
99

Docket 130-99

Report of the Board

The above entitled cause came on regularly for hearing on the 9th day of December, 1999, in the Billings Petroleum Club, Billings, Montana, pursuant to the order of the Board of Oil and Gas Conservation of the State of Montana, hereinafter referred to as the Board. At this time and place testimony was presented, statements and exhibits were received, and the Board then took the cause under advisement; and, the Board having fully considered the testimony, statements and exhibits and all things and matters presented to it for its consideration by all parties in the Docket, and being well and fully advised in the premises, finds and concludes as follows:

Findings of Fact

1. Due, proper and sufficient notice was published and given of this matter, the hearing hereon, and of the time and place of said hearing, as well as the purpose of said

hearing; all parties were afforded opportunity to present evidence, oral and documentary.

2. Current interest in developing coal bed methane reserves in the Powder River Basin has raised concerns about the effects of such development on groundwater in the area because production of such reserves will require dewatering the coal beds

3.

Order

IT IS THEREFORE ORDERED by the Board of Oil and Gas Conservation of the State of Montana that this general order applies to coal bed methane wells drilled on private and state land in the Powder River Basin Controlled Groundwater Area as established by the Department of Natural Resources and Conservation. It does not apply to lands owned by Indian Tribes or held in trust by the United States for Indian Tribes or individual Indians.

1. Applications for permit to drill exploratory wells to determine the potential for coal bed methane (CBM) production will be approved as wildcat gas wells under existing rules. Well density is limited to one well per section, setback at least 990 feet from the section lines. Locations must be advertised and the ten day waiting period prior to approval applies.

2. Wells drilled for the purpose of exploring for or producing CBM must meet the drilling, completion and plugging requirements of any other well under the Board's general rules and regulations. However, wells that are drilled to the top of the target coal and have casing set and cemented back to surface need not be equipped with a separate string of production casing.

3. Requests for temporary spacing units of less than 640 acres or for increased well density for a test pod of wells or for a "pilot" project of limited scope may be authorized by the Board after notice and public hearing. Notice of public hearing will be published by the Board in the manner customarily used by it; the applicant must provide actual notice of proposed hearing to the record owners as required under Section 82-11-141(4)(b), MCA, and to water right holders in the temporary spacing unit proposed for the pilot project.

4. An application for public hearing to establish permanent spacing and field rules for a CBM development project must include such information as is customarily required for establishment of well spacing and field rules for conventional gas production. Applicants must also present at the hearing a field development plan including maps, cross-sections and a description of the existing hydrologic resources, including water wells or springs that may be affected by the project, and a copy of the water mitigation agreement being

used or proposed for use in the project area. The applicant must provide an estimated time frame for development activities, a monitoring/evaluation plan for water resources in the project area, the proposed number and location of key wells which will be used to determine water levels and aquifer recovery data, and water quality information for target coal aquifers available at the time of hearing. The Board will publish its customary notice of public hearing; the applicant must provide actual notice as required in Section 82-11-141(4)(b), MCA, and must notify all record water rights holders within one-half mile of the exterior boundary of the proposed field area.

5. Notice to water rights holders must be given by mailing the written notice, postage prepaid, to the address shown by the records of the Department of Natural Resources and Conservation at the time notice is given. The notice must briefly summarize the application and provide the time and place of the public hearing.

6. Coal bed methane operators must offer water mitigation agreements to owners of water wells or natural springs within one-half mile of a CBM field proposed for approval by the Board or within the area that the operator reasonably believes may be impacted by a CBM production operation, whichever is greater. This area will be automatically extended one-half mile beyond any water well or natural spring adversely affected. The mitigation agreement must provide for prompt supplementation or replacement of water from any natural spring or water well adversely affected by the CBM project and shall be under such conditions as the parties mutually agree upon. Mitigation agreements are intended to address the reduction or loss of water resources and may exclude mechanical, electrical, or similar loss of productivity not resulting from a reduction in the amount of available water due to production from CBM wells. The Board will review areas covered by mitigation agreements as part of its review of field development proposals.

7. Coal bed methane production will be reported on Board Form No. 6 and will include produced volumes of both gas and water. Form No. 6 will be filed for all unplugged CBM wells even if the only production reported is water. An initial pre-production static water level will be reported for each newly completed CBM well at the time Form No. 4 is filed. For those wells designated as key wells, the operator will report an annual shut-in static fluid level following a shut-in period of at least 48 hours or such lesser time as is adequate to determine a stabilized level. For those wells designated as dedicated monitoring wells, a quarterly fluid level will be reported.

8. The requirement to run electric or radioactive wells logs will be met if the operator logs one well in each quarter section to the deepest target CBM horizon. The minimum log required is a gamma-ray log, which may be run through pipe; however, a gamma ray-density log in open hole is recommended.

9. Approval of development plans and establishment of field rules and spacing requirements will be under such conditions and time frames as the Board may deem adequate.

Done and performed by the Board of Oil and Gas Conservation of the State of Montana
at Billings, Montana, this 9th day of December, 1999.

BOARD OF OIL AND GAS
CONSERVATION
OF THE STATE OF MONTANA

Dave Ballard, Chairman

Denzil Young, Vice-Chairman

George Galuska, Board Member

Jack King, Board Member

Allen Kolstad, Board Member

Stanley Lund, Board Member

Elaine Mitchell, Board Member

ATTEST:

Terri Perrigo, Executive Secretary